

# BIOMETHANE GAS QUALITY STANDARDS

Testing, On-going Monitoring and Point of Receipt Maintenance

# Biomethane Quality Specification

- » In 2014, the **CPUC adopted concentration standards for 17 constituents** of concern found in biomethane, and adopted certain monitoring, testing, reporting, and recordkeeping protocols that the biomethane producers and gas utilities must comply with.

## SoCalGas/SDG&E Rule 30 J.5. PG&E Rule 21 C.3. SWG Rule 22

Constituent	Trigger Level mg/m <sup>3</sup> (ppm <sub>v</sub> ) <sup>i</sup>	Lower Action Level mg/m <sup>3</sup> (ppm <sub>v</sub> )	Upper Action Level mg/m <sup>3</sup> (ppm <sub>v</sub> )
<i>Health Protective Constituent Levels</i>			
<u>Carcinogenic Constituents</u>			
Arsenic	0.019 (0.006)	0.19 (0.06)	0.48 (0.15)
p-Dichlorobenzenes	5.7 (0.95)	57 (9.5)	140 (24)
Ethylbenzene	26 (6.0)	260 (60)	650 (150)
n-Nitroso-di-n-propylamine	0.033 (0.006)	0.33 (0.06)	0.81 (0.15)
Vinyl Chloride	0.84 (0.33)	8.4 (3.3)	21 (8.3)
<u>Non-Carcinogenic Constituents</u>			
Antimony	0.60 (0.12)	6.0 (1.2)	30 (6.1)
Copper	0.060 (0.02)	0.6 (0.23)	3 (1.2)
Hydrogen Sulfide	30 (22)	300 (216)	1500 (1080)
Lead	0.075 (0.009)	0.75 (0.09)	3.8 (0.44)
Methacrolein	1.1 (0.37)	11 (3.7)	53 (18)
Toluene	904 (240)	9000 (2400)	45000 (12000)
Alkyl Thiols (mercaptans)	(12)	(120)	(610)
<i>Pipeline Integrity Protective Constituent Levels<sup>ii</sup></i>			
Siloxanes	0.01 mg Si/m <sup>3</sup>	0.1 mg Si/m <sup>3</sup>	-
Ammonia	0.001 vol%	-	-
Hydrogen	0.1 vol%	-	-
Mercury	0.08 mg/m <sup>3</sup>	-	-
Biologicals	4 x 10 <sup>4</sup> /scf (qPCR per APB, SRB, IOB <sup>iii</sup> group) and commercially free of bacteria of >0.2 microns	-	-

# Test Preparation Procedure

1. Determine compounds to be tested by source
2. Determine reporting limits for each compound
3. Contact outside labs.
4. Labs will provide test apparatus, turn around time, cost, sampling instructions and shipping info.

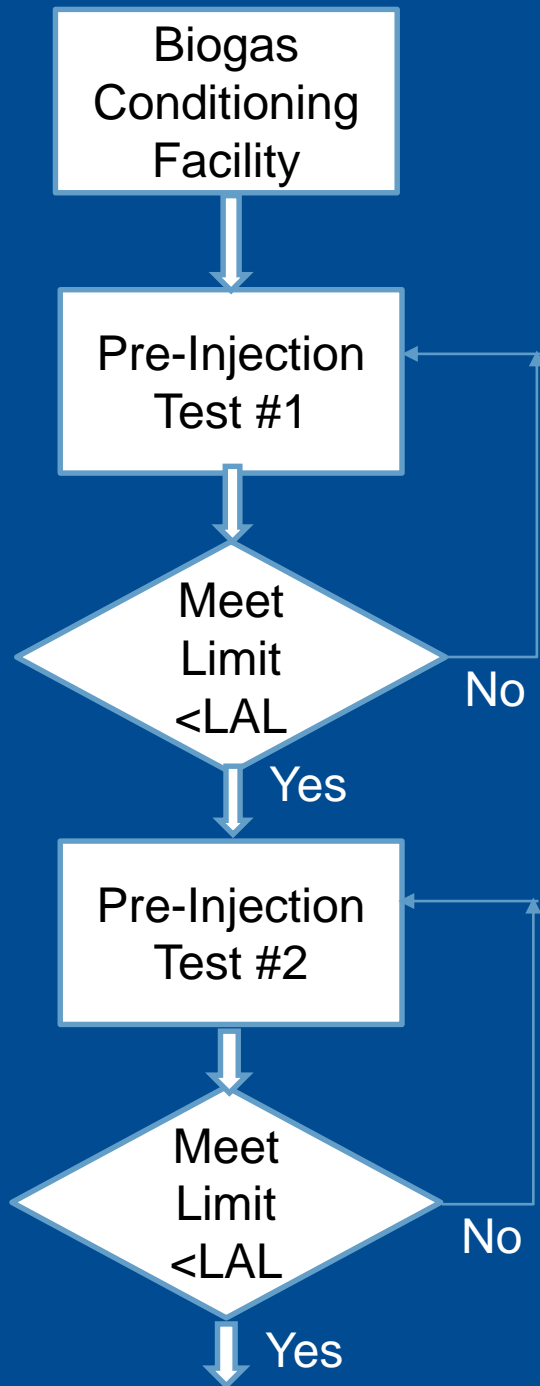
Biomethane Constituents	CAS #	Trigger Level		Testing by Biogas Source		
		mg/m3	ppmv	Landfill	Dairies	Other
Arsenic	7440-38-2	0.019	0.006	x		
p-Dichlorobenzene	106-46-7	5.7	0.95	x		x
Ethylbenzene	100-41-4	26	6	x	x	x
n-Nitroso-di-n-propylamine	621-64-7	0.033	0.006	x	x	
Vinyl Chloride	75-01-4	0.84	0.33	x		x
Antimony	7440-36-0	0.6	0.12	x		
Copper	7440-50-8	0.06	0.02	x		
Hydrogen Sulfide	7883-06-4	30	22	x	x	x
Lead	7439-92-1	0.075	0.009	x		
Methacrolein	78-85-3	1.1	0.37	x		
Alkyl thiols (mercaptans)		NA	12	x	x	x
Toluene	108-88-3	904	240	x	x	x
Siloxanes		0.1	NA	x	*	x
Ammonia	7664-41-7		10	x	x	x
Hydrogen			1000	x	x	x
Mercury	7439-97-6	0.08		x	x	x
Biological	MICs	$4 \times 10^4$	copies/scf	x	x	x

# Sampling Method

1. Select sample tap on top of flowing pipeline downstream of plant
2. Build sample line: tubing, valve or regulator, test apparatus, and flow meter.
3. Collect samples at specified flow, test duration or volume. If instructed, shield from sun and keep cool.
4. Label samples and complete Chain of Custody (COC).
5. Ship samples with COC to lab by sample hold time and temperature conditions.



Constituent	Examples of: Sampling Method	Test Method
Arsenic	Impinger, Filter	ICP/MS (EPA 6010B)
p-Dichlorobenzene	Summa Canister	GC/MS (EPA TO-15)
Ethylbenzene	Summa Canister	GC/MS (EPA TO-15)
n-Nitroso-di-n-propylamine	Sorbent Tube	GC/MS (EPA 8270)
Vinyl Chloride	Summa Canister	GC/MS (EPA TO-15)
Antimony	Impinger, Filter	ICP/MS (EPA 6010B)
Copper	Impinger, Filter	ICP/MS (EPA 6010B)
Hydrogen Sulfide	Bag, Canister	GC/SCD (ASTM D5504)
Lead	Impinger, Filter	ICP/MS (EPA 6010B)
Methacrolein	Cartridge, tube	HPLC (EPA TO-11)
Alkyl thiols (mercaptans)	Bag, Canister	GC/SCD (ASTM D5504)
Toluene	Summa Canister	GC/MS (EPA TO-15)
Siloxanes	Anasorb Tube	GC/MS (EPA TO-15)
Ammonia	Anasorb 747 Tube	ISE (OSHA ID-164)
Hydrogen	Summa Canister	GC/PDD
Mercury	Impinger, Tube	AA (EPA 7470A)
Biological	Filter	qPCR for MICs



## Pre-injection Testing

- » Supplier conducts two tests over a two to four week period downstream of their Processing Plant
- » If the Health Protective Constituents total potential cancer risk and non-cancer risk and Pipeline Integrity Protection Constituents are below the Lower Action Level, the biomethane may be injected into the pipeline.



MSA built and connected

Instrument Specialists setup MSA

PLCs programmed, communicates to devices and alarms

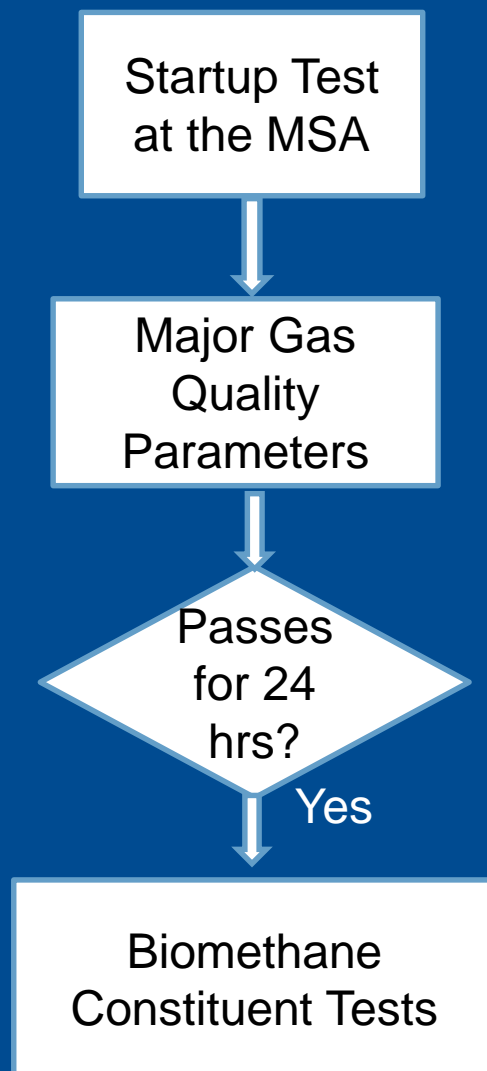
Validation of gas quality analyzers

Pass?

Yes

## Commissioning Point of Receipt (MSA)





## Startup Test and Flow into Utility Pipeline

Parameters	PG&E	SCG/SDGE	SWG
Heating Value (BTU/cf)	Not specified	970-1150	950-1150
Water (lb/MMscf)	7	7	7
Hydrogen Sulfide (Gr/100scf)	0.25	0.25	0.25 (4 ppmv)
Mercaptan Sulfur (Gr S/100scf)	0.5	0.3	-
Total Sulfur (Gr S/100scf)	1.0	0.75	5 (85 ppmv)
Carbon Dioxide	1%	3%	2%
Oxygen	0.1%	0.2%	0.2%
Nitrogen	Not specified		3%
Inerts	Not specified	4%	4%
Hydrocarbons	45°F	45°F	20°F
Temperature	60 – 100°F	50-105°F	40-120°F
Interchangeability	AGA 36	1279-1385 AGA36	-

# On-going Gas Quality Monitoring and Test at Point of Receipt

1. Calibrations are daily for GCs
2. Annual validations of analyzers
3. Monthly inspections and checks of analyzers
4. Scheduled Maintenance Program

**Analyzers can continuously monitor the biomethane at utility interconnection point:**

- Energy Content
- Carbon Dioxide (CO<sub>2</sub>)
- Hydrogen Sulfide (H<sub>2</sub>S)
- Oxygen (O<sub>2</sub>)
- Moisture (H<sub>2</sub>O) analyzers
- Total Sulfur

These analyzers can send data and alarms to Gas Control or programmable logic controller (PLC)



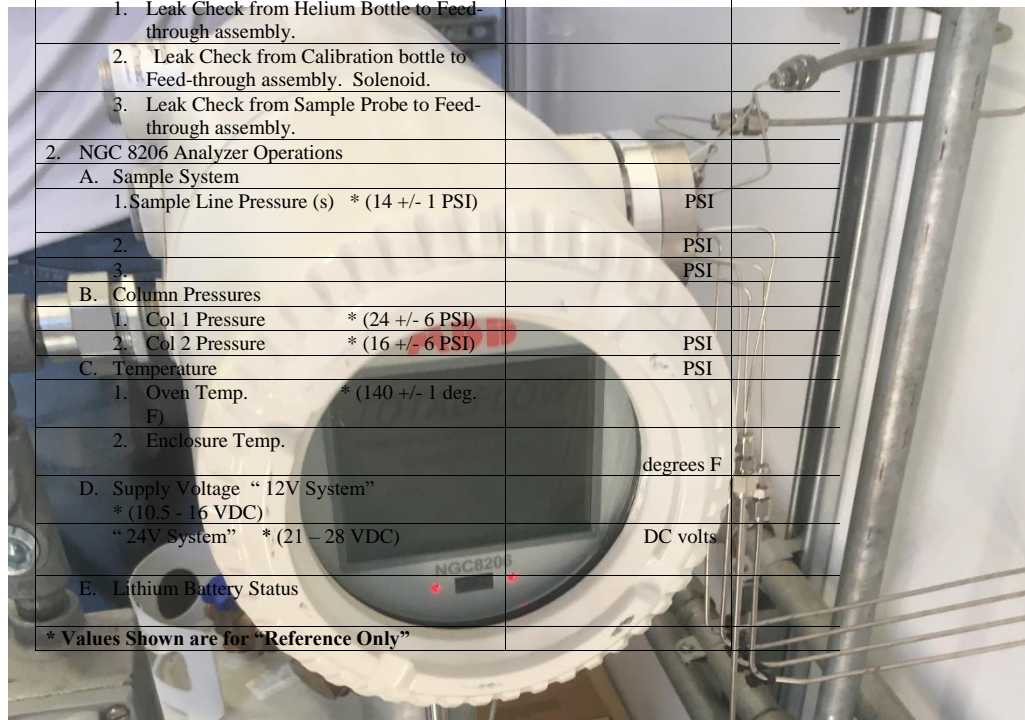


# On-going Maintenance of GC

1. 2.5 hrs inspection/month
2. Calibration gas – 2 years
3. Helium carrier gas – 3-6 months.
4. Filters – 2 years.
5. Parts – 2 years.

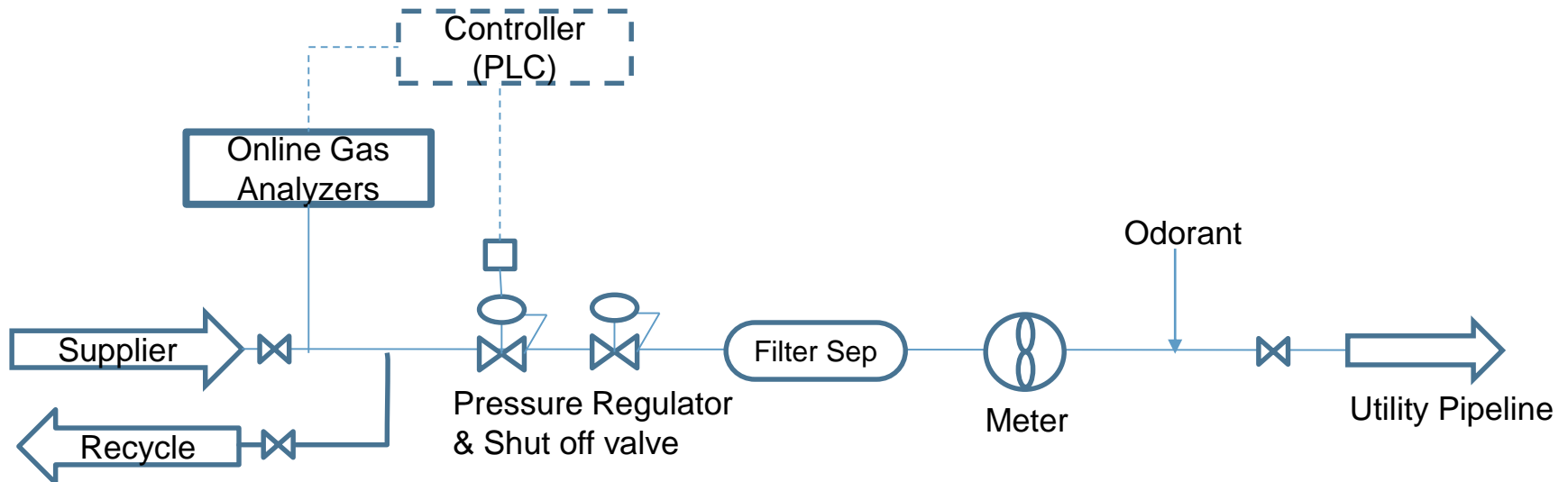
## Example of GC Inspection Report

1. Bottle and Regulator Equipment	As Found	As I
A. Helium Carrier Cylinder 1		
1. High Pressure Reading * (500-2500 PSI)	Psig	
2. Outlet Pressure Reading * ( 100 +/- 5 PSI)	Psig	
B. Helium Carrier Cylinder 2		
1. High Pressure Reading * (500-2500 PSI)	Psig	
2. Outlet Pressure Reading * ( 120 +/- 5 PSI)	Psig	
C. Helium Regulator * ( 90 +/- 5 PSI)	Psig	
D. Calibration Gas Cylinder Number:		
3. High Pressure Reading	Psig	
4. Outlet Pressure Reading * (15 +/- 1 PSI)	Psig	
E. Leak Testing:		
1. Leak Check from Helium Bottle to Feed-through assembly.		
2. Leak Check from Calibration bottle to Feed-through assembly. Solenoid.		
3. Leak Check from Sample Probe to Feed-through assembly.		
2. NGC 8206 Analyzer Operations		
A. Sample System		
1. Sample Line Pressure (s) * (14 +/- 1 PSI)	PSI	
2.	PSI	
3.	PSI	
B. Column Pressures		
1. Col 1 Pressure * (24 +/- 6 PSI)		
2. Col 2 Pressure * (16 +/- 6 PSI)	PSI	
C. Temperature		
1. Oven Temp. * (140 +/- 1 deg. F)		
2. Enclosure Temp.		degrees F
D. Supply Voltage " 12V System"		
* (10.5 - 16 VDC)		
" 24V System" * (21 - 28 VDC)		DC volts
E. Lithium Battery Status		
* Values Shown are for "Reference Only"		



# On-going Gas Quality Monitoring and Enforcement

- » Continuous online gas analyzers will alarm and the controller will automatically shut off valve if not compliant.
- » Gas is rejected back to be recycled through the supplier's process plant.
- » Shut off valve will be opened once alarm is cleared.



# PRODUCER DATA VIEWED REMOTELY

Southern California Gas Company

Main

Producer Sites

Version

3 - [Redacted] Producer: <b>Montezuma Pass</b> Communication: <b>IP Modem</b>	Odorant GC	SOV1 	SOV2 	3 - [Redacted] Producer: [Redacted] Communication: <b>IP Modem</b>	Odorant GC	SOV1 	SOV2 
3 - [Redacted] Producer: <b>Camelback</b> Communication: <b>IP Modem</b>	Odorant GC	SOV1 	SOV2 	4 - [Redacted] Producer: [Redacted] Communication: <b>IP Modem</b>	GC	SOV1 	SOV2 
3 - [Redacted] Producer: <b>A [Redacted]</b> Communication: <b>IP Modem</b>	Odorant GC	SOV1 	SOV2 	5 - [Redacted] Producer: <b>C [Redacted]</b> Communication: <b>IP Modem</b>	GC	SOV1 	SOV2 
3 - [Redacted] Producer: [Redacted] Communication: <b>IP Modem</b>	Odorant GC	SOV1 	SOV2 	5 - [Redacted] Producer: [Redacted] Communication: <b>IP Modem</b>	Odorant GC	SOV1 	SOV2 
3 - [Redacted] Producer: <b>V [Redacted]</b> Communication: <b>IP Modem</b>	GC	SOV1 	SOV2 	5 - [Redacted] Producer: <b>Pop Warner</b> Communication: <b>IP Modem</b>	Odorant GC	SOV1 	SOV2 
3 - [Redacted] Producer: <b>V [Redacted]</b> Communication: <b>IP Modem</b>	GC	SOV1 	SOV2 				

Open  
 Shut-in  
 No SOV  
 Bad Data

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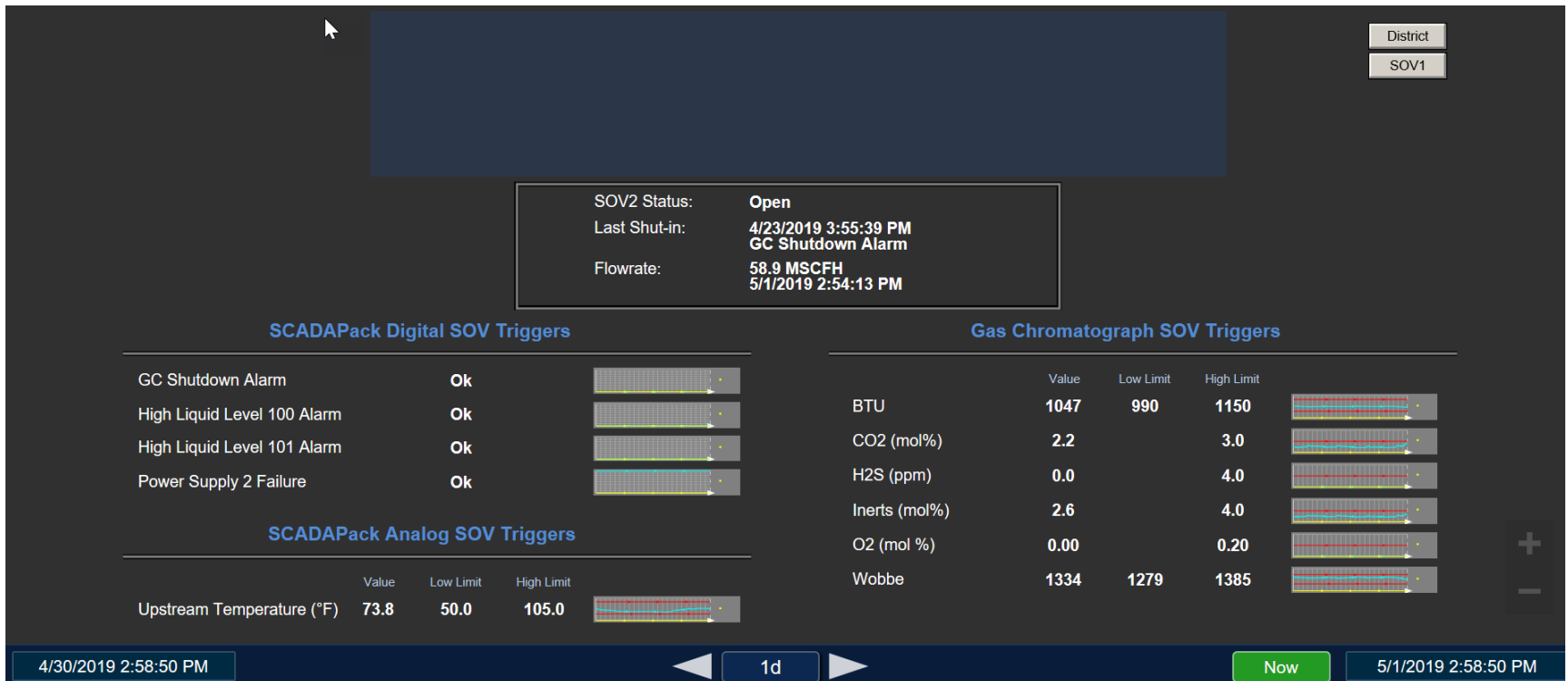
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# DATA STORAGE AND GAS QUALITY ALARMS



# Periodic Tests

- » Monthly Tests e.g., hydrocarbon and water dew points



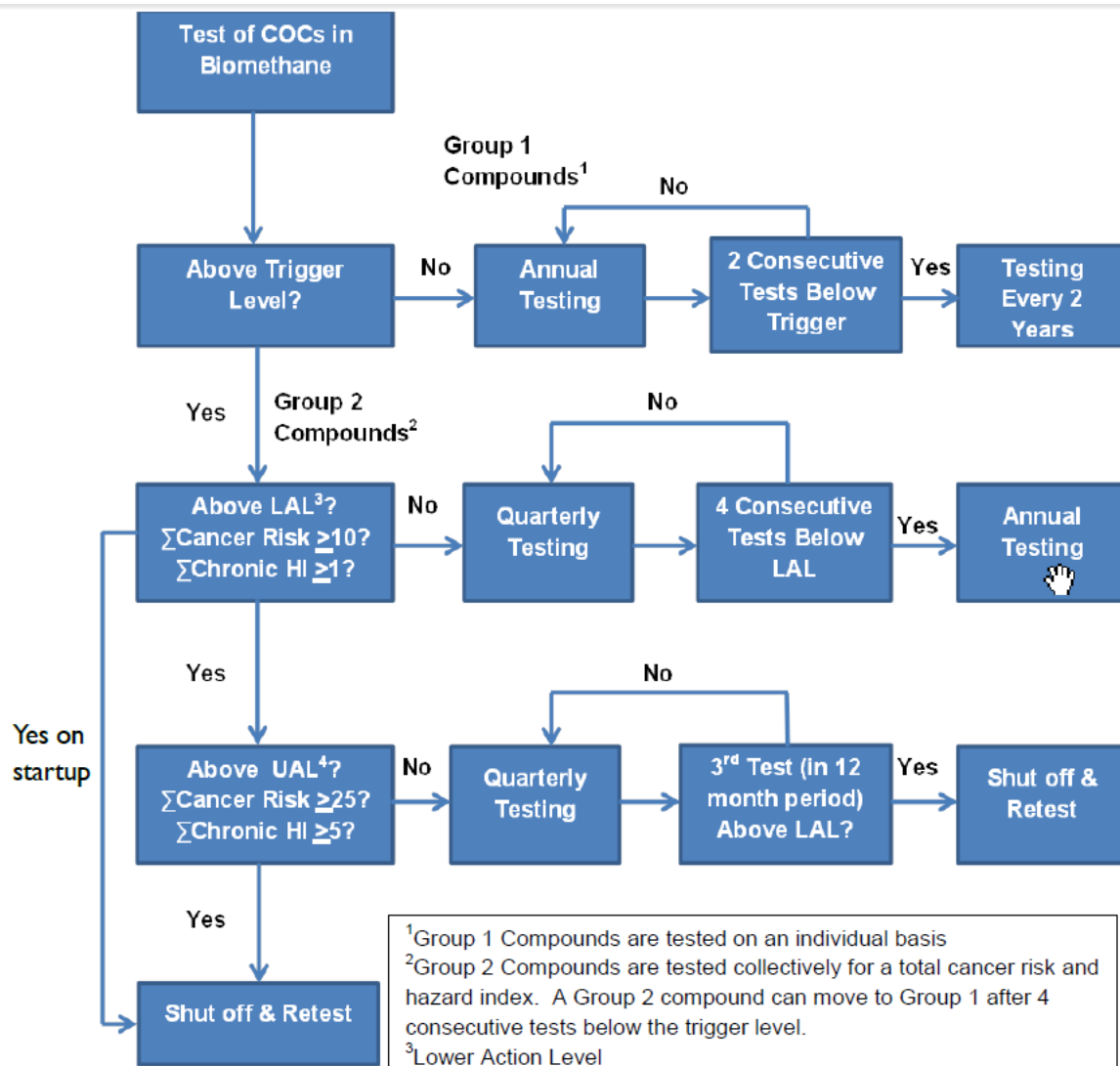


# Biomethane Test Frequency

- » Below Trigger – Annually or Biannually
- » Above Trigger – Quarterly
- » Above LAL – Quarterly
- » Shut offs
- » LAL – 3 tests
- » UAL - Immediate

## CARB Flow chart on frequency of the monitoring for constituents of concern

<http://www.arb.ca.gov/energy/biogas/documents/errata2014.pdf>



# Biomethane Calculator

- » Risk Calculator is available online
- » Sum of the [Concentration] divided by Trigger

## Biomethane Constituents of Concern Health Risk Calculator

VERSION 3/25/2014

Carcinogenic Constituents of Concern				
Constituent of Concern	mg/m <sup>3</sup>	ppmv	Cancer Risk (Chances per million)	Risk Level
Arsenic				
p-Dichlorobenzene				
Ethylbenzene				
n-Nitroso-di-n-propylamine				
Vinyl Chloride				
Total Chances Per Million**			0.0	Below Lower Action Level
Non-carcinogenic Constituents of Concern				
Constituent of Concern	mg/m <sup>3</sup>	ppmv	Hazard Quotient	Risk Level
Antimony				
Copper				
Hydrogen Sulfide				
Lead				
Methacrolein				
Alkyl thiols (mercaptans)*				
Toluene				
Total Hazard Index**			0.0	Below Lower Action Level

# Test Reports

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1. Test reports sent in 1-2 weeks after sample receipt.
2. Summarize results in one table.
3. Enter the Health Protective Constituents in the calculator.
4. Calculator or chart will determine the action and test frequency.
5. Lab reports sent to utility or supplier within 5 days.
6. Biomethane test report sent to CPUC upon injection.
7. Test data resulting in shutoffs are provided to supplier and CPUC within 24 hours of receiving report.
8. Biomethane test reports sent annually to CPUC.